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WILLAMETTE RIVER SAMPLING AND ANALYSIS PLAN
Site Inspections
Portland Harbor, Oregon

Prepared for
U.S. Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, Washington 98101

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Willamette River
Sampling and Analysis Plan
Portland Harbor, Oregon

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SECTION 1

INTRODUCTION

Pursuant to United States Environmental Protection Agency (EPA) Contract No. 68-W9-0046, Roy F. Weston, Inc. (WESTON) is conducting a Site Inspection (SI) in the Willamette River from river mile (RM) 3.5 to RM 9.5 (see Figure 1-1). The EPA Site Inspection process is intended to evaluate actual or potential environmental hazards at a particular site relative to other sites across the nation for the purpose of identifying remedial action priorities. The SI, under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA) is intended to collect sufficient data to enable evaluation of a site's potential for inclusion on the National Priorities List (NPL) and establish priorities for additional action, if warranted. The decision as to whether a site is placed on the NPL is made based on the EPA's Revised Hazard Ranking System (HRS) criteria. The HRS assesses the relative threat to human health and the environment associated with the actual or potential releases of hazardous substances at a site.

This Sampling and Analysis Plan (SAP), which is to be used in conjunction with the Quality Assurance Program Plan (QAPP) (WESTON, 1994) as amended by WESTON's 30 June 1997 letter, describes the activities that will collect sufficient data to support an HRS evaluation. In total, five discrete river reaches have been established (Figure 1-1) and an individual HRS evaluation will be conducted for each reach. The data collection efforts in this project area are also intended to support the Oregon Department of Environmental Quality's (ODEQ's) ongoing investigations of the potential need for remedial actions associated with possible upland sources adjacent to the Willamette River.

The purpose of this investigation is to provide an assessment of sediment contamination in the Portland Harbor reach of the Willamette River. The specific objectives of this investigation are to:

- Characterize the nature and areal extent of sediment contamination distribution in surface sediments
- Characterize the nature and vertical extent of sediment contaminant distribution in shallow subsurface sediments

The methods and procedures for sample collection and handling to address the above objectives are described herein, and will be pursued according to the 40 CFR Part 300, Hazard Ranking System, Final Rule. This SAP, and hence, the SI process, does not include extensive or complete site characterization, contaminant fate determination, or quantitative risk assessment.

SECTION 2

BACKGROUND

2.1 SITE LOCATION AND DESCRIPTION

The Willamette River originates in the Cascade Mountain Range and flows approximately 187 miles north before discharging into the Columbia River, which flows an additional 100 miles westward to the Pacific Ocean. The point of confluence of the Willamette and Columbia rivers denotes RM 0. Most development along the Willamette River has occurred within the project area, referred to as the Portland Harbor. Portland Harbor has been dredged to provide a shipping channel generally 300 feet wide and 40 feet deep from the mouth of the Willamette River upriver to the Broadway Bridge (RM 11.8) (Caldwell and Doyle, 1995). Channel depths currently range from 10 to 140 feet, with an average depth of 45 feet. In this reach, the river is deep, slow moving, and tidally influenced. During periods of medium and low flows, tidal effects are evident to RM 26.5 (Willamette Falls); reverse flow has been measured as far upstream as Ross Island (RM 15) during low flow periods.

Habitat in the Willamette River near Portland has been altered to accommodate urban development and a growing shipping industry. Shoreline features include steeply sloped banks covered with riprap or constructed bulkheads, with manmade structures such as piers and wharves extending out over the water. Because of dredging, many portions of the riverbed are steeply sloped and maintain substrates composed mainly of silts and sands (Farr and Ward, 1991).

2.2 INDUSTRIAL OPERATIONS IN THE PROJECT AREA

Much of the upland areas adjacent to the Willamette River within Portland Harbor are heavily industrialized, and marine traffic within the river is considered to be intensive. Within the 6-mile project area, a number of industrial operations have been identified as potential sources of contamination to sediment in the Willamette River. Historical or current industrial operations include hazardous waste storage; marine construction; bulk petroleum product storage and handling; oil fire fighting training activities; oil gasification plant operations; wood-treating; agricultural chemical production; battery processing; liquid natural gas plant operations; chlorine production; ship loading and unloading; ship maintenance and repair (i.e., sandblasting, scaling, repair, painting, refueling); and rail car manufacturing.

Numerous past investigations within the Portland Harbor area have been conducted at varying levels of scope. A portion of the studies focused on specific properties, while the remaining studies were river-wide and incorporated sediment sampling as one component of the entire study. A summary of existing sediment chemical data is provided in the Executive Summary of Historical Sediment Data (WESTON, 1997). Past sediment studies have demonstrated the presence of polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs), dioxins, metals, organotins, pentachlorophenol, and solvents in sediment. These contaminants may have entered the river via spillage during product shipping and handling, direct disposal or discharge, accidental spills, contaminated groundwater discharge, surface water runoff, stormwater discharge, or contaminated soil erosion.

2.3 AQUATIC RESOURCES AND CRITICAL HABITATS

Recent studies have identified 39 species of fish in the Willamette River within the project area. The lower Willamette River upstream to the Willamette Falls provides a significant migratory corridor, nursery habitat, and adult forage area for two runs of chinook, two runs of steelhead, and individual runs of coho and sockeye salmon (Massey, 1992; Farr and Ward, 1991). In general, chinook and steelhead populations are the largest and most widespread of the salmonids found in the Willamette River basin (Melcher, 1992). Steelhead salmon utilizing the Willamette River are being considered for placement on the threatened species list of the Endangered Species Act of 1973. Pacific lamprey are also present in the river and are currently classified as a species of special concern by the U.S. Fish and Wildlife Service (USFWS). Species of special concern are qualified as those organisms whose conservation status is of concern to the USFWS, but for which further information is needed.

Commercial fishing in the Willamette River within the project area is limited to a small Pacific lamprey fishery (Melcher, 1992). In contrast, recreational fishing is extremely popular throughout the lower Willamette basin. Highest angling pressure is directed toward spring chinook, steelhead, coho, American shad, and white sturgeon. Resident species such as largemouth bass, black crappie, white crappie, and walleye also support a significant recreational fishery (Farr and Ward, 1991).

Numerous piscivorous birds, migratory water fowl, and raptors utilize the lower Willamette River during various times of the year. Great blue heron, osprey, merganser, kingfisher, and bald eagle routinely forage within the study area. Both great blue heron and osprey nest sites are located adjacent to the river and represent significant potential receptors.

SECTION 3

FIELD ACTIVITIES

3.1 SAMPLING LOCATIONS AND RATIONALE

The overall purposes of conducting sediment sampling activities in the Willamette River are to generate data that can be used for HRS scoring, to provide information on contaminant distribution in the Portland Harbor area, and to support potential future investigations within the river. The sampling plan therefore focuses on identifying areas of sediment contamination. Based on historical data, contaminants of potential concern in sediment include metals, base-neutral acid extractables (BNAs) (primarily PAHs), PCBs, pesticides, and organotins. Because organotins are of potential concern, the sampling plan will also focus on evaluating the potential bioavailability of organotins to aquatic receptors through the collection and analysis of sediment porewater. In addition, the uncertainties associated with the bioavailability of metals bound in sandblast grit or paint chips will be investigated as part of the proposed sediment and porewater sampling approach.

The investigation of the extent of contamination in the Willamette River will be based on collection of river sediment, primarily in the nearshore areas of each reach. For this study, an elevation of -2 feet MLLW is proposed. Because only limited bathymetric data are available for any given site, it is not currently possible to confirm that all proposed sampling locations are positioned as desired relative to mudline depths. Therefore, final determinations will be made in the field and may require the adjustment of proposed sampling locations (see also Section 4.1.5).

Surface sediment (10 cm; 4 inches) will be collected at 151 locations over the entire study area. Subsurface sediment samples extending up to 60 inches (152 cm) below mudline will also be collected at a subset (40 stations) of the surface sampling locations to assess depth of contamination. Subsurface sediment coring stations will be positioned approximately every 0.5 mile along both sides of the river at distances between 50 and 500 feet from the shoreline, as well as in areas adjacent to more heavily industrialized upland properties.

The five discrete river reaches established for the purposes of the HRS evaluations are delineated in Figure 3-1 and defined as follows:

- Reach A: RM 3.5 - RM 5.0
- Reach B: RM 5.0 - RM 6.0
- Reach C: RM 6.0 - RM 7.0
- Reach D: RM 7.0 - RM 8.0

- Reach E: RM 8.0 - RM 9.5

River reaches were established based on the boundaries of adjacent upland facilities, adjacent land uses (both current and historical), and areal coverage. The specific sampling locations and rationale for each reach are discussed in the following sections.

3.1.1 River Reach A

3.1.1.1 Surface Sediment Sampling

A total of 35 surface (0 to 10 cm) sediment stations (for a total of 36 samples, including one duplicate) will be sampled within the boundaries of Reach A (RM 3.5 to RM 5; Figure 3-2). All surface sediment samples will be analyzed for Target Analyte List (TAL) metals and BNAs (Table 5-2; Table 3-1). Many bulk petroleum facilities and industrial operations are present throughout Reach A that routinely handle(d) compounds containing BNAs (WESTON, 1997). Consequently, all surface sediment samples collected within this reach will be analyzed for these semivolatile organic compounds. In addition, all surface sediment samples will be analyzed for total organic carbon (TOC) and grain size, which will be used in the interpretation of data. Sediment concentrations for organics are typically normalized to TOC, while sediment concentrations for inorganics can be normalized to grain size, aluminum, or manganese.

A total of eight of the surface sediment stations (for a total of 9 samples, including one duplicate) will also be analyzed for pesticides and PCBs to evaluate the potential distribution of these analytes in river sediment. The analyses for these compounds will be conducted on samples collected approximately every 0.5 river mile.

This reach of the river also contains shipping facilities. Organotins are a potential contaminant of concern and will be analyzed at eight surface sediment stations (for a total of nine samples, including one duplicate). Similar to pesticides and PCBs, organotin samples will be collected every 0.5 river mile to provide more comprehensive areal distribution of sediment organotin concentrations. Titanium, which forms the pigment base for many newer paints (i.e., paints manufactured since the 1970s), will be analyzed as an indicator of paint chips and their potential contribution to sediment. Nine titanium samples (including one duplicate) at the same eight stations as the organotin analyses will be collected. Additional sediment volume will be collected for eight porewater analyses at these same eight organotin bulk chemistry surface sediment sampling locations within this reach; the porewater samples will be analyzed for TAL metals and organotins.

Table 3-1 summarizes the surface sediment and porewater samples proposed to be collected from Reach A.

3.1.1.2 Subsurface Sediment Sampling

Subsurface (0 to 152 cm) sediment core samples will be collected from eight of the surface sediment sampling stations within the boundaries of Reach A to evaluate the vertical extent of sediment contamination. All subsurface sediment samples representing the 0 to 90 cm horizon will be analyzed for TAL metals, BNAs, TOC, and grain size. Four subsurface sediment samples will also be analyzed for titanium, PCBs, pesticides, and organotins.

Sediment core samples representing the horizon between 90 and 152 cm will be archived for potential future analysis if the maximum depth of contamination cannot be established based on the upper analytical interval.

Table 3-1 summarizes the subsurface sediment samples proposed to be collected from Reach A.

3.1.2 River Reach B

3.1.2.1 Surface Sediment Sampling

A total of 21 surface (0 to 10 cm) sediment stations (for a total of 22 samples, including one duplicate) will be sampled within the boundaries of Reach B (RM 5.0 to RM 6.0; Figure 3-3). All surface sediment samples will be analyzed for TAL metals and BNAs. Bulk petroleum facilities and industrial shipping operations are present throughout Reach B that routinely handle(d) compounds containing BNAs (WESTON, 1997). Consequently, all surface sediment samples collected within this reach will be analyzed for these semivolatile organic compounds. In addition, all surface sediment samples will be analyzed for TOC and grain size, which will be used in the interpretation of data.

A total of four of the surface sediment stations (for a total of 5 samples, including one duplicate) will also be analyzed for pesticides and PCBs to evaluate the potential distribution of these analytes in river sediment. The analyses for these compounds will be conducted on samples collected approximately every 0.5 river mile.

In addition, seven of the surface sediment stations (for a total of 8 samples, including one duplicate) will be analyzed for organotins and titanium to evaluate the potential distribution of these compounds in the Willamette River sediment. The analyses for these compounds will be conducted on samples near boat maintenance facilities where painting or hull scraping activities have occurred and on samples collected approximately every 0.5 river mile to evaluate the potential distribution in river sediment (see WESTON, 1997). Additional sediment volume will be collected for seven porewater analyses at these same seven organotin bulk chemistry surface sediment sampling locations within this reach; the porewater samples will be analyzed for TAL metals and organotins.

Table 3-2 summarizes the surface sediment and porewater samples proposed to be collected from Reach B.

3.1.2.2 Subsurface Sediment Sampling

Subsurface (0 to 152 cm) sediment core samples will be collected from four of the surface sediment sampling stations (for a total of 5 samples, including one duplicate sample) within the boundaries of Reach B to evaluate the vertical extent of sediment contamination. All subsurface sediment samples representing the 0 to 90 cm horizon will be analyzed for TAL metals, titanium, BNAs, PCBs, pesticides, organotins, TOC, and grain size. Sediment core samples representing the horizon between 90 and 152 cm will be archived for potential future analysis if the maximum depth of contamination cannot be established based on the upper analytical interval.

Table 3-2 summarizes the subsurface sediment samples proposed to be collected from Reach B.

3.1.3 River Reach C

3.1.3.1 Surface Sediment Sampling

A total of 22 surface (0 to 10 cm) sediment stations (for a total of 23 samples, including one duplicate) will be sampled within the boundaries of Reach C (RM 6.0 to RM 7.0; Figure 3-4). All surface sediment samples will be analyzed for TAL metals and BNAs. Facilities are present in Reach C that routinely handle(d) compounds containing BNAs (WESTON, 1997). Consequently, all surface sediment samples collected within this reach will be analyzed for these semivolatile organic compounds. In addition, all surface sediment samples will be analyzed for TOC and grain size, which will be used in the interpretation of data.

A total of eight of the surface sediment stations (for a total of 9 samples, including one duplicate) will be analyzed for PCBs, organotins, and titanium. The analyses for these compounds will be conducted on samples collected approximately every 0.5 river mile to evaluate the potential distribution of these analytes in river sediment, as well as in areas where their handling or use has been documented (see WESTON, 1997). A total of nine of the surface sediment stations (for a total of ten samples, including one duplicate) will also be analyzed for pesticides. The analyses for these compounds will be conducted on samples collected approximately every 0.5 river mile to evaluate the potential distribution of these analytes in river sediment, as well as in areas where their handling or use has been documented (see WESTON, 1997).

Additional sediment volume will be collected for seven porewater analyses at six organotin bulk chemistry surface sediment sampling locations within this reach; the porewater samples will be analyzed for TAL metals and organotins.

Table 3-3 summarizes the surface sediment and porewater samples proposed to be collected from Reach C.

3.1.3.2 Subsurface Sediment Sampling

Seven subsurface (0 to 152 cm) sediment core samples will be collected from seven of the surface sediment sampling stations within the boundaries of Reach C to evaluate the vertical extent of sediment contamination. Six of these subsurface sediment samples representing the 0 to 90 cm horizon will be analyzed for TAL metals, titanium, BNAs, PCBs, pesticides, organotins, TOC, and grain size. One of the seven subsurface sediment samples will be analyzed for TAL metals, BNAs, pesticides, TOC, and grain size. Sediment core samples representing the horizon between 90 and 152 cm will be archived for potential future analysis if the maximum depth of contamination cannot be established based on the upper analytical interval.

Table 3-3 summarizes the subsurface sediment samples proposed to be collected from Reach C.

3.1.4 River Reach D

3.1.4.1 Surface Sediment Sampling

A total of 41 surface (0 to 10 cm) sediment stations (for a total of 43 samples, including two duplicates) will be sampled within the boundaries of Reach D (RM 7.0 to RM 8.0; Figure 3-5). All surface sediment samples will be analyzed for TAL metals and BNAs. Facilities are present in Reach D that routinely handle(d) or manufacture(d) compounds containing BNAs, metals, and other organic chemicals (WESTON, 1997). Consequently, all surface sediment samples collected within this reach will be analyzed for these organic and inorganic chemicals. In addition, all surface sediment samples will be analyzed for TOC and grain size, which will be used in the interpretation of data.

A total of 14 of the surface sediment stations (for a total of 16 samples, including 2 duplicates) will be analyzed for pesticides to evaluate the potential distribution of these analytes in river sediment. A total of 12 of the surface sediment stations (for a total of 14 samples, including two duplicates) will also be analyzed for PCBs, and a total of 17 of the surface sediment stations (for a total of 19 samples, including two duplicates) will be analyzed for organotins and titanium. The analyses for these compounds will be conducted on samples collected approximately every 0.5 river mile, as well as in areas where their handling or use has been documented (see WESTON, 1997).

Additional sediment volume will be collected for five porewater samples at five of the organotin bulk chemistry surface sediment sampling locations within this reach; the porewater samples will be analyzed for TAL metals and organotins.

Table 3-4 summarizes the surface sediment and porewater samples proposed to be collected from Reach D.

3.1.4.2 Subsurface Sediment Sampling

Subsurface (0 to 152 cm) sediment core samples will be collected from nine of the surface sediment sampling stations (for a total of ten samples, including one duplicate) within the boundaries of Reach D to evaluate the vertical extent of sediment contamination. All subsurface sediment samples representing the 0 to 90 cm horizon will be analyzed for TAL metals, BNAs, TOC, and grain size. Seven subsurface sediment stations (for a total of 8 samples, including one duplicate) will also be analyzed for PCBs and pesticides, while six of the subsurface sediment samples will be analyzed for titanium and organotins. Sediment core samples representing the horizon between 90 and 152 cm will be archived for potential future analysis if the maximum depth of contamination cannot be established based on the upper analytical interval.

Table 3-4 summarizes the subsurface sediment samples proposed to be collected from Reach D.

3.1.5 River Reach E

3.1.5.1 Surface Sediment Sampling

A total of 32 surface (0 to 10 cm) sediment stations (for a total of 35 samples, including 3 duplicates) will be sampled within the boundaries of Reach E (RM 8.0 to RM 9.5; Figure 3-6). All surface sediment samples will be analyzed for TAL metals and BNAs. Facilities are present in Reach E that routinely handle(d) or manufacture(d) compounds containing BNAs and metals (WESTON, 1997). Consequently, all surface sediment samples collected within this reach will be analyzed for these organic and inorganic chemicals. In addition, all surface sediment samples will be analyzed for TOC and grain size, which will be used in the interpretation of data.

A total of five of the surface sediment stations (for a total of 8 samples, including 3 duplicates) will be analyzed for pesticides to evaluate the potential distribution of these analytes in river sediment. The analyses for these compounds will be conducted on samples collected approximately every 0.5 river mile.

A total of 13 of the surface sediment stations (for a total of 16 samples, including 3 duplicates) will be analyzed for PCBs to evaluate the potential distribution of these analytes in river sediment. The analyses for these compounds will also be conducted on samples collected approximately every 0.5 river mile, as well as in areas where their handling or use has been documented (see WESTON, 1997).

In addition, 19 of the surface sediment stations (for a total of 22 samples, including 3 duplicates) collected near the boat maintenance facilities where painting or hull scraping activities have occurred will be analyzed for organotins and titanium to evaluate the potential distribution of these compounds in the Willamette River sediment. The analyses for these compounds will be conducted on samples collected approximately every 0.5 river mile, as well as in areas where their handling or use has been documented (see WESTON, 1997). Additional sediment volume will be collected for porewater analysis at six of these organotin bulk chemistry surface sediment sampling locations (for a total of seven samples, including one duplicate) within this reach; the porewater samples will be analyzed for TAL metals and organotins.

Table 3-5 summarizes the surface sediment and porewater samples proposed to be collected from Reach E.

3.1.5.2 Subsurface Sediment Sampling

Twelve subsurface (0 to 152 cm) sediment core samples will be collected from 12 of the surface sediment sampling locations within the boundaries of Reach E to evaluate the vertical extent of sediment contamination. All subsurface sediment samples representing the 0 to 90 cm horizon will be analyzed for TAL metals, BNAs, TOC, and grain size. Nine of the subsurface sediment samples will be analyzed for organotins and titanium, while eight subsurface samples will be analyzed for PCBs. Four subsurface sediment samples will be analyzed for pesticides. Sediment core samples representing the horizon between 90 and 152 cm will be archived for potential future analysis if the maximum depth of contamination cannot be established based on the upper analytical interval.

Table 3-5 summarizes the subsurface sediment samples proposed to be collected from Reach E.

SECTION 4

METHODS AND PROCEDURES

4.1 SAMPLING AND ANALYTICAL METHODS

4.1.1 Surface Sediment Sampling

Surface (0 to 10 cm) sediment for chemical testing will be collected in accordance with Puget Sound Estuary Program (PSEP) protocols (PSEP, 1986 with updates). Samples will be collected using a modified 0.1 m^2 van Veen grab sampler. The sampler will be deployed from a sampling vessel of adequate size using a hydraulic winch system rigged to minimize the twisting forces on the sampler during deployment. The descent of the van Veen will be controlled by onboard personnel at a rate of approximately 1 ft/sec to minimize wake and probability of improper orientation upon contact with the bottom. Depth to sediment, station coordinates, and time will be recorded at the moment the grab sampling device contacts the bottom. The grab sampler will be retrieved at a rate of approximately 1 ft/sec to minimize potential disturbance of the sediment surface within the sampler.

Upon retrieval, the van Veen will be braced onboard in an upright position using wooden blocks. The access flaps will be opened and the overlying water will be slowly removed using a siphon. If excessive water leakage is evidenced by lack of an overlying water layer or excessive water turbidity is observed, the sample will be rejected prior to any additional characterization. For grab samples initially accepted based on minimal water leakage and turbidity, the condition of the collected sediment will be visually characterized per the following criteria to determine overall sample acceptability:

- Sediment is not pressed against the inside top of or extruding from the sampler.
- Sediment surface appears to be relatively undisturbed (i.e., flat with minimal winnowing).
- Minimum penetration depths are achieved:

  Medium-coarse sand - 4 to 5 cm
  Fine sand - 6 to 7 cm
  Silts/clays - 10 cm

Samples that do not meet any one of the above criteria will be rejected and the station will be re-sampled. Locations at which a 10-cm penetration depth cannot be consistently obtained due to the physical characteristics of the sediment will be represented by the maximum obtainable depth. Corrective actions that may be employed in the field to address potential sampler overfilling or consistent under-penetration include the removal or addition of weights or buoys to the van Veen to address these problems. After a grab sample is deemed acceptable, the following observations will be recorded on the field sample record forms (see Section 4.3):

- Sediment penetration depth (nearest 0.5 cm) based on sediment depth at the center of the grab.
- Physical characteristics of the surface sediment, including color, texture, presence of grit or paint chips, and presence and type of biological structures, other debris, sheens, or odors.
- Physical characteristics of the vertical profile, including changes in sediment characteristics and presence and depth of potential redox layers, or layers of sandblast grit or paint chips.

Sediment will be removed from the van Veen grab sampler using decontaminated stainless-steel spoons or trowels, placed in stainless-steel soup pots, and homogenized using a power drill fitted with a stainless-steel mixing paddle (necessary because of the relatively large volumes of sediment required for analyses and it ensures better mixing). All subsamples for laboratory analysis will be placed in labeled, laboratory-cleaned sample jars. Care will be taken to ensure that sediment in contact with the inside of the van Veen, as well as any large items of debris, are excluded from the samples for laboratory analysis.

At stations at which sediment will be collected for bulk sediment chemistry and conventionals, and porewater for both organotins and metals analyses, approximately four acceptable van Veen grabs (or about 8 liters of sediment) are anticipated to be required. This assumption is based on a collection volume of approximately 2 liters of sediment per grab, with 2 liters required for bulk sediment analyses and 6 liters of sediment required to obtain 1.5 liters of porewater (as a conservative estimate, porewater is assumed to constitute only 25 percent of the sediment volume). Where porewater analyses are limited to organotins, only two sediment grabs (4 liters less of sediment or 1 liter less of porewater) are estimated to be required. The number of van Veen grabs will be adjusted upward if, as previously described, consistent 10-cm grabs cannot be attained due to substrate composition.

4.1.2 Subsurface Sediment Sampling

Subsurface sediment sampling will be conducted using a 3-inch-diameter gravity corer. The gravity corer will be configured with a core barrel capable of recovering 5-foot cores (approximately 152 cm) and will weigh about 500 pounds when empty. The sampler will be deployed from a sampling vessel of adequate size using a hydraulic winch system rigged with swivel tackle to minimize the twisting forces on the sampler during deployment. Once the sampler is deployed, a winch capable of lifting approximately 2,500 pounds will be required to overcome the weight of the sediment in the sampler and the friction exerted on the sides of the core barrel.

It should be noted that gravity corer samplers tend to experience greater difficulty penetrating coarser sediment (e.g., sand). Because sediment grain size within the Willamette River tends to become increasingly coarser towards the mouth of the river, the subsurface sediment sampling phase will commence at the farthest downriver sampling locations (i.e., Reach A) to determine the potential limits of adequate sampler penetration and recovery. It is currently proposed that sediment collected from 0 to 90 cm (3.0 feet) be submitted for chemical analysis based on anticipated recovery depths and sediment volume requirements for laboratory analysis, and that the remaining sediment (i.e., 90 to 152 cm [5 feet]) be archived for potential future chemical analysis. However, if limited sediment penetration or recovery is consistently encountered at the downriver locations, then the proposed core interval for chemical analysis may be adjusted downward (e.g., from 0 to 60 cm or 2.0 feet). Such a contingency action would be implemented following consultation with the EPA Work Assignment Manager (WAM).

The descent of the gravity corer will be controlled by an onboard winch operator at a rate of approximately 1 ft/sec to minimize wake and probability of improper orientation upon contact with the bottom. Depth to sediment, station coordinates, and time will be recorded at the moment the gravity core sampling device contacts the bottom. The gravity corer will be retrieved at a rate of approximately 1 ft/sec to preserve the integrity of the sample (i.e., minimize the potential for washout).

Upon retrieval, the gravity core will be braced horizontally onboard by field personnel and stabilized with wooden blocks. The nosepiece and eggshell core catcher will be removed and a polyethylene cap will be placed over the bottom of the acetate core liner and secured with tape. The acetate core liner will then be removed from the core barrel and raised vertically with the bottom-side-down. A second polyethylene cap will be secured over the top of the core liner and the station number will be written on both the top of the cap and the side of the liner. Any overlying water will be drained by drilling a hole in the core liner slightly above the sediment/water interface. The depth to sediment from the top of the coring tube will be measured and recorded. Collected cores will be fixed vertically to a secured point on the sampling vessel (e.g., a railing or bulkhead) with heavy gauge rope for temporary storage until processing.

Core processing will be conducted either onboard the sampling vessel or at an onshore location with adequate facilities. Sediment from each core will be extruded onto a decontaminated 5-foot stainless-steel tray by elevating the tube at an angle. If sediment is seized within the liner due to over-compaction and/or coarse grain size, the liner will be tapped with a rubber mallet to loosen the sediment from the core liner. Care will be taken to ensure that samples are extruded as slowly as possible to maintain the cylindrical form of the core. Once the core sediment is extruded onto the tray, the following observations will be recorded on the field sample record forms (see Section 4.3):

- Physical characteristics of the subsurface sediment, including color, texture, presence of anthropogenic material (e.g., sandblast grit, paint chips), and presence and type of biological structures, other debris, sheens, or odors.

- Physical characteristics of the vertical profile, including changes in sediment characteristics and presence and depth of potential redox layers or layers of product, sandblast grit, or paint chips.

Sediment will be removed from the stainless steel tray using decontaminated stainless-steel spoons or trowels, placed in 60-quart stainless-steel container, and homogenized using an electric drill fitted with a stainless-steel mixing paddle. All samples will be placed in labeled, laboratory-cleaned sample jars. Care will be taken to ensure that any large items of debris are excluded from all samples.

Sediment collected from the 0- to 90-cm interval with be analyzed for bulk sediment chemistry per Section 3, and conventionals, which will require approximately 2 liters of sediment. It is anticipated that only one core will be required to be collected at each station to meet this volume requirement, as 3 feet of sediment in a 3-inch core provides approximately 5.5 liters of sediment.

4.1.3 Station Positioning Requirements

A differential global positioning system (DGPS) is the preferred surveying system for samples collected from a sampling vessel. The DGPS consists of a GPS receiver mounted at a fixed point (e.g., top of A-frame or sampling platform) on the vessel and a differential receiver located at a horizontal control point. At the control point, the GPS position is compared to the known horizontal location. Offsets or biases are identified and used to develop correction factors, which are sent to the GPS receiver located on the vessel. DGPS is typically accurate to within 1 to 3 meters, depending on satellite position. The GPS provides the operator with a listing of time intervals during the day when accuracies are decreased, so these periods can be avoided, if possible. If DGPS is not available, a hand-held GPS unit (if available from EPA) will be used to document station positions. The accuracy of this system is several hundred feet.

The exact locations of the proposed subtidal sampling locations will be determined in the field based on visual markers, such as shoreline features and channel markers, and depth to bottom (for targeting sideslope and channel stations), which will be measured using an onboard fathometer. Bottom depths will be tidally corrected in the field. Once "on-station," the DGPS will be used to record actual station positions. It is anticipated that these data will be reported in State Plane Coordinates; latitude and longitude will also be reported, if the sampling vessel contractor has this capability.

4.2 SAMPLE HANDLING, PACKAGING, AND SHIPMENT

4.2.1 Sample Containers

To preserve sample integrity, proper sample containers will be used for parameters designated in this program. Precleaned sample containers will be obtained from the analytical laboratory or a scientific supply vendor. Containers will be precleaned per the requirements in EPA guidance documents (EPA, 1989).

Container requirements vary according to analyte, sample matrix, and hazard classification. It is anticipated that samples collected for the project will be low hazard. Table 4-1 summarizes the type and number of sample containers required for the sampling program.

4.2.2 Sample Packaging

Custody seals and completed EPA sample tags will be placed on each sample container. Sample containers will then be placed in a resealable plastic bag and placed in an appropriate shipping container (steel-belted cooler) lined with a polyethylene bag. Sufficient vermiculite will be added to prevent breakage of sample containers and to absorb spills in the event of breakage. Double-bagged ice will be placed on top of the vermiculite if cooling is required for sample preservation. The polyethylene bag will then be twisted shut and secured. Region X Field Sample Data Sheets, Chain-of-Custody forms, Contract Laboratory Program (CLP) Traffic Report forms, and any other pertinent sample documentation will be placed in a resealable plastic bag and taped to the inside cover of the cooler. Custody seals will be placed on the front and back of the cooler, and the cooler will be taped shut.

4.2.3 Sample Shipment

Shipping and handling of samples will be done in a manner that protects both the sample integrity and shipment handlers from the possible hazardous nature of the samples. Samples will be shipped by Federal Express Priority One air service. Packaging, marking, labeling, and shipping of samples will comply with regulations promulgated by the International Air Transport Association regulations. Detailed requirements are discussed in the CLP User's Guide (EPA, 1991).

WESTON will establish an account to provide return delivery of coolers from the laboratories. Return delivery will be by surface transport, if possible. Written return shipping instructions will be provided to the laboratory when samples are delivered, specifying carrier names and account numbers for return of coolers.

4.3 DOCUMENTATION

4.3.1 Field Documentation

All pertinent field information will be recorded in ink in a bound logbook. At a minimum, the following information will be recorded in the daily logbook:

- Date and time of entry (24-hour clock)
- Project name and location
- Project number
- Time and duration of daily sampling activities
- Weather conditions
- Variations, if any, from required sampling protocols and reasons for deviations
- Name of person making field entries and other field personnel
- On-site visitors, if any
- General methods of sample collection
- Levels of personal protection
- Any other observations useful in reconstructing field activities.

Field sample records specific to each type of sampling activity will also be maintained by field personnel. An example sediment collection field form is provided in Appendix A. Additional information that will be documented on these field sample records includes sample numbers and station identifiers, and for sediment collected from a sampling vessel, the name of the sampling vessel and subcontractor, actual sample coordinates, tidal information, the depth to sediment (i.e., water depths and tidally corrected mudline elevations), and the observations described in Sections 4.1.1 and 4.1.2.

Sample documentation forms for laboratory analyses will be obtained through the EPA Regional Sample Control Coordinator (RSCC).

4.3.2 Sample Designation and Labeling

All samples collected will be assigned a unique WESTON identification code based on a consistent sample designation scheme. The sample designation scheme is designed to suit the needs of the field staff, data management and data users.

All samples will consist of four components separated by a dash. These components are site ID, media code, station code, and sample type. The sample designation scheme is as follows:

Site ID		Media Code		Station Code		Sample Type
SS	-	MM	-	SSsss	-	t ddd I

The four components are described in the following sections.

Site ID

The site ID component is a two-letter code that designates the specific Site Investigation sample. The site ID code assigned for this investigation is WR for Willamette River.

Media Code

The media code is a two-character code that defines the media type of the sample. The media codes designated for this project are as follows:

SD - Sediment

PW - Porewater (Note: Porewater will be extracted from surface sediments by the contracted laboratory, but the sediments designated for extraction will be assigned the "PW" media code in the field.)

Station Code

The station code component is a five character code that uniquely identifies the sampling station. The two-character "SS" code assigned for this investigation is "SD," followed by a three-digit "sss" numbering scheme (e.g., 001, 002, etc.).

Sample Type

The sample type component has three parts: a sample type field "t," a sample depth field "ddd, " and a core sample field "i." The single character "t" indicates a sample type having one of the following two values:

0 - Field sample
1 - Field duplicate

The three-character "ddd" is a depth indicator, where the sample collection depth is represented by the top of the sampling interval in tenths of feet.

The "i" field is a single-digit component that will be used for sediment core samples collected from the same station as surface (0 to 10 cm) sediments. The letter "A" will be assigned to core samples representing the top interval sampled (e.g., 0 to 3 feet).

Examples

Examples of complete sample numbers with descriptions are as follows:

WR-SD-SD004-0000: A surface (0 to 10 cm) sediment sample collected from Station SD014.

WR-SD-SD017-1000: A duplicate surface (0 to 10 cm) sediment sample collected from Station SD017.

WR-PW-SD020-0000: A surface sediment porewater sample collected from Station SD020.

WR-SD-SD004-0000A: A subsurface sediment sample (representing the subsurface horizon starting at 0 foot) collected from Station SD004.

4.3.3 Chain-of-Custody Procedures

Sample custody is a critical aspect of environmental investigations, particularly when the data may be used in litigation. The possession and proper handling of samples must be traceable from the time the samples are collected until the data have been accepted for analysis so that re-analyzes may be conducted without concern for possible introduction of contaminants.

The purpose of custody procedures is to provide a documented, legally defensible record that can be used to follow the possession and handling of a sample from collection through analysis. A sample is in custody if it is:

- In someone's physical possession or view, and/or
- Secured to prevent tampering, and/or
- Secured in an area restricted to authorized personnel.

4.3.3.1 Field Custody Procedures

Sample control and chain-of-custody procedures in the field and during shipment will be performed in accordance with the procedures in the CLP User's Guide (EPA, 1991).

Each sample will be assigned a unique identifying number. Labels will be filled out in waterproof ink prior to sample collection to minimize container handling. Sample label and chain-of-custody forms will include the following information:

- Name of sampler
- Date and time of sample collection
- Sample number
- Sample matrix and how collected (i.e., grab, composite)
- Preservation method
- Analyses required

Sample documentation forms for laboratory analyses will be obtained through the EPA RSCC. Examples of sample documentation forms were provided in Appendix B of the QAPP (WESTON, 1994). Internal WESTON sample names will not be placed on the chain of custodies or sample bottles.

4.3.3.2 Laboratory Custody Procedures

Laboratories supporting this project shall have custody procedures commensurate with the EPA Region X Manchester Laboratory SOP, the EPA Contract Laboratory Program Statement of Work (CLP SOW), or Special Analytical Services Basic Ordering Agreement (SAS BOA). These procedures document and describe the acceptance, internal transfer, and final reporting of samples.

4.4 EQUIPMENT DECONTAMINATION

Equipment decontamination will be required to prevent contamination of clean areas and cross-contamination of samples, and to maintain the health and safety of field personnel. Decontamination of all sampling equipment will be required.

Dedicated or disposable sampling equipment will be used when feasible to reduce the possibility of sample cross-contamination. WESTON will attempt to have sufficient sampling equipment available to allow for decontamination at the end of each day rather than between individual samples; however, some equipment, such as the van Veen grab sampler, will require decontamination between each sampling location. Equipment that cannot be effectively decontaminated (e.g., siphon tubing) will be disposed of after each sampling event. Equipment that is likely to require field decontamination includes, but is not limited to:

- Stainless-steel trowels and spoons
- Stainless-steel mixing bowls and soup pots
- van Veen grab sampler
- Acetate core liners
- Stainless-steel mixing paddle

The field decontamination procedure for sampling equipment such as those items listed above will consist of the following steps:

1. Liquinox detergent wash (or some other non-phosphate detergent)
2. Tap or seawater rinse
3. Deionized water rinse
4. Air dry, if possible, away from potential sources of contamination (e.g., splashes)
5. Wrap or cover in aluminum foil (shiny side out)
6. Store in plastic bags (when possible)

Solvents (i.e., methanol and hexane) will be available for use in the decontamination process if sticky residues are encountered. If used, solvent rinses would occur between steps (2) and (3) listed above.

4.5 INVESTIGATION-DERIVED WASTE

All efforts will be made to minimize investigation-derived waste (IDW) that cannot be disposed of as solid waste. Disposal of personal protective equipment and disposable sampling equipment will be double-bagged and treated as solid waste. Decontamination water containing methanol and hexane will be considered hazardous waste. To minimize generation of hazardous decontamination water, it will be used sparingly and separated from non-hazardous decontamination water (e.g., containing only Alconox). All hazardous IDW will be handled and disposed of in an EPA-approved manner.

SECTION 5

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Field and laboratory quality assurance/quality control (QA/QC) will be based on the EPA-approved QAPP (WESTON, 1994).

5.1 FIELD QA/QC SAMPLES

Field QC samples will consist of sample duplicates. Field duplicate samples are designed to monitor overall sampling and analytical precision. Blind field duplicates will consist of an homogenized sample that is split into two sample aliquots. Field duplicate frequency will be 5 percent of each matrix collected or once per sampling event, whichever is more frequent. Samples will be assigned unique numbers and will not be identified as duplicates to the laboratory. Table 5-1 presents field QA/QC samples to be collected.

5.2 LABORATORY QA/QC SAMPLES

The quality of analytical data is controlled by the frequency and type of internal quality control checks developed for each analysis type. Laboratory results will be evaluated by reviewing results for analysis of method blanks, matrix spikes, duplicate samples, laboratory control samples, calibrations, performance evaluation samples, interference checks, etc., as specified in analytical methods.

5.2.1 Method Blanks

Method blanks usually consist of laboratory reagent-grade water treated in the same manner as the sample (e.g., digested, extracted, distilled, etc.) then analyzed and reported as a standard sample. The analysis of method blanks serves as a check on reagents and equipment to ensure that they are contaminant-free.

5.2.2 Surrogate Compound Recovery

Surrogate compounds are organic compounds similar to the analytes of interest in chemical composition, extraction and chromatographic properties, but are not normally found in environmental samples. These compounds are spiked into laboratory samples for VOC, BNA, and PCB analyses. Percent recoveries are calculated for each surrogate compound in each sample. These recoveries give an indication of the accuracy of the analytical method.

5.2.3 Matrix Spikes

A matrix spike is an aliquot of a field sample that is fortified (spiked) with the analytes of interest and analyzed with an associated sample batch to monitor the effects of the field sample matrix (matrix effects) on the analytical method.

Samples for matrix spike and matrix spike duplicate analysis will be designated by the WESTON field coordinator. QC samples will be selected based on visual and field monitoring results. An effort will be made to ensure that QC samples are representative of the samples analyzed (i.e., the most contaminated or cleanest samples will not be selected).

5.2.4 Laboratory Duplicate Samples

Duplicate samples are obtained by splitting a field sample into two separate aliquots in the laboratory and performing two separate analyses on the aliquots. The analysis of laboratory duplicates monitors sample precision.

Samples for laboratory duplicate analysis will be designated by the WESTON field coordinator. QC samples will be selected based on visual and field monitoring results. An effort will be made to ensure that QC samples are representative of the samples analyzed (i.e., the most contaminated or cleanest samples will not be selected).

5.2.5 Laboratory Control Samples

A laboratory control sample is identified to the analyst so that it is used to check the accuracy of an analytical procedure. It is particularly applicable when a minor revision or adjustment has been made to the analytical procedure or instrument. Known samples are usually analyzed along with blind samples to monitor performance. Continuing calibration verification analysis may be used as a laboratory control when specified by the analytical method.

5.3 QUANTITATION LIMITS

Quantitation limit goals for the sediment and porewater sampling events are presented in Tables 5-2 and 5-3, respectively. Actual analyte detection limits are matrix- and sample-dependent and may be higher depending upon sample moisture content, analytical interferences, and any required sample dilutions. The laboratories will make best efforts to achieve quantitation limit goals. Additional sample cleanup steps or method modifications may be required in some cases. The quantitation limits were selected to ensure that data could be directly compared with existing sediment and porewater screening values.

SECTION 6

HEALTH AND SAFETY

Prior to beginning field work for this project, a detailed project-specific Health and Safety Plan (HASP) will be prepared by WESTON. This plan will detail all the chemical, physical, and biological hazards that may be encountered while on-site performing the tasks outlined in this plan.

SECTION 7

SCHEDULE

Figure 7-1 provides the schedule for the Willamette River SIs.

SECTION 8

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TABLES

Table 3-1—Reach A Sampling Locations and Analyses

Sample Number	Location	Sample Depth (bgs)	Elevation (ft MLLW)	Analysis: TAL Metals	Titanium	BNAs	PCBs	Pest.	Organo-tins	TOC	Grain Size
Surface and Subsurface Sediment											
WR-SD-SD001 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD002 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD003 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD004 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD005 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD006 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD007 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD008 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD009 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD010 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD011 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD012 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD013 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD014 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD015 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD016 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD017 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD018 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD019 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD020 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD020 -1000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD021 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD022 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD023 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD024 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD025 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD026 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD027 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD028 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD029 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD030 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD031 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X

033

Table 3-1—Reach A Sampling Locations and Analyses

Sample Number	Location	Sample Depth (bgs)	Elevation (ft MLLW)	Analysis: TAL Metals	Titanium	BNAs	PCBs	Pest.	Organo-tins	TOC	Grain Size
WR-SD-SD032 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD033 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD034 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD035 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
Subsurface Sediment											
WR-SD-SD001 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD004 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD012 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD015 -0000A	Willamette River	0 - 90 cm[b]	< -2	X		X				X	X
WR-SD-SD016 -0000A	Willamette River	0 - 90 cm[b]	< -2	X		X				X	X
WR-SD-SD022 -0000A	Willamette River	0 - 90 cm[b]	< -2	X		X				X	X
WR-SD-SD031 -0000A	Willamette River	0 - 90 cm[b]	< -2	X		X				X	X
WR-SD-SD035 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
Sediment Porewater											
WR-PW-SD001 -0000	see SD-SD001	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD004 -0000	see SD-SD004	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD011 -0000	see SD-SD011	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD012 -0000	see SD-SD012	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD020 -0000	see SD-SD020	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD021 -0000	see SD-SD021	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD034 -0000	see SD-SD034	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD035 -0000	see SD-SD035	0 - 10 cm[a]	< -2	X					X		

[a]Sediment sampling depth from which porewater will be extracted.

[b]90-152cm sediment horizon to be archived.

Sample numbers ending in 1000 are duplicate samples.

034

Table 3-2—Reach B Sampling Locations and Analyses

Sample Number	Location	Sample Depth (bgs)	Elevation (ft MLLW)	Analysis							
				TAL Metals	Titanium	BNAs	PCBs	Pest.	Organo-tins	TOC	Grain Size
Surface Sediment											
WR-SD-SD036 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD037 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD038 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD039 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD040 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD041 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD042 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD043 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD044 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD045 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD046 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD047 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD048 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD048 -1000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD049 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD050 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD051 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD052 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD053 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD054 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD055 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD056 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
Subsurface Sediment											
WR-SD-SD048 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD048 -1000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD049 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD054 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD055 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
Sediment Porewater											
WR-PW-SD048 -0000	see SD-SD048	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD049 -0000	see SD-SD049	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD051 -0000	see SD-SD051	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD053 -0000	see SD-SD053	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD054 -0000	see SD-SD054	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD055 -0000	see SD-SD055	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD056 -0000	see SD-SD056	0 - 10 cm[a]	< -2	X					X		

[a]Sediment sampling depth from which porewater will be extracted.

[b]*90-152cm sediment horizon to be archived.*

Sample numbers ending in 1000 are duplicate samples.

035

Table 3-3—Reach C Sampling Locations and Analyses

Sample Number	Location	Sample Depth (bgs)	Elevation (ft MLLW)	Analysis: TAL Metals	Titanium	BNAs	PCBs	Pest.	Organo-tins	TOC	Grain Size
Surface Sediment											
WR-SD-SD057 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD058 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD059 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD060 -0000	Willamette River	0 - 10 cm	< -2	X		X			X	X	X
WR-SD-SD061 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD062 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD063 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD064 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD065 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD066 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD067 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD068 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD069 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD070 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD070 -1000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD071 -0000	Willamette River	0 - 10 cm	< -2	X		X			X	X	X
WR-SD-SD072 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD073 -0000	Willamette River	0 - 10 cm	< -2	X		X			X	X	X
WR-SD-SD074 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD075 -0000	Willamette River	0 - 10 cm	< -2	X		X		X		X	X
WR-SD-SD076 -0000	Willamette River	0 - 10 cm	< -2	X		X			X	X	X
WR-SD-SD077 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD078 -0000	Willamette River	0 - 10 cm	< -2	X		X		X		X	X
Subsurface Sediment											
WR-SD-SD057 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD058 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD066 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD072 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD074 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD077 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD078 -0000A	Willamette River	0 - 90 cm[b]	< -2	X		X		X		X	X
Sediment Porewater											
WR-PW-SD057 -0000	see SD-SD057	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD058 -0000	see SD-SD058	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD064 -0000	see SD-SD064	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD070 -0000	see SD-SD070	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD074 -0000	see SD-SD074	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD074 -1000	see SD-SD074	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD077 -0000	see SD-SD077	0 - 10 cm[a]	< -2	X					X		

[a]Sediment sampling depth from which porewater will be extracted.

[b]90-152cm sediment horizon to be archived.

Sample numbers ending in 1000 are duplicate samples.

036

Table 3-4—Reach D Sampling Locations and Analyses

Sample Number	Location	Sample Depth (bgs)	Elevation (ft MLLW)	Analysis							
				TAL Metals	Titanium	BNAs	PCBs	Pest.	Organo-tins	TOC	Grain Size
Surface Sediment											
WR-SD-SD079 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD080 -0000	Willamette River	0 - 10 cm	< -2	X		X		X		X	X
WR-SD-SD081 -0000	Willamette River	0 - 10 cm	< -2	X		X	X	X		X	X
WR-SD-SD082 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD083 -0000	Willamette River	0 - 10 cm	< -2	X		X		X		X	X
WR-SD-SD084 -0000	Willamette River	0 - 10 cm	< -2	X		X	X	X		X	X
WR-SD-SD085 -0000	Willamette River	0 - 10 cm	< -2	X		X		X		X	X
WR-SD-SD086 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD087 -0000	Willamette River	0 - 10 cm	< -2	X		X	X	X		X	X
WR-SD-SD088 -0000	Willamette River	0 - 10 cm	< -2	X		X		X		X	X
WR-SD-SD089 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD090 -0000	Willamette River	0 - 10 cm	< -2	X		X	X	X		X	X
WR-SD-SD091 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD092 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD092 -1000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD093 -0000	Willamette River	0 - 10 cm	< -2	X		X		X		X	X
WR-SD-SD094 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD095 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD096 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD097 -0000	Willamette River	0 - 10 cm	< -2	X		X		X		X	X
WR-SD-SD098 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD099 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD100 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD101 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD102 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD103 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD104 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD105 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD106 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD107 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD108 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD109 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD110 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD111 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X

037

038

Table 3-4—Reach D Sampling Locations and Analyses

Sample Number	Location	Sample Depth (bgs)	Elevation (ft MLLW)	Analysis: TAL Metals	Titanium	BNAs	PCBs	Pest.	Organo-tins	TOC	Grain Size
WR-SD-SD112 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD113 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD114 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD115 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD116 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD117 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD117 -1000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD118 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD119 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
Subsurface Sediment											
WR-SD-SD084 -0000A	Willamette River	0 - 90 cm[b]	< -2	X		X	X	X		X	X
WR-SD-SD084 -1000A	Willamette River	0 - 90 cm[b]	< -2	X		X	X	X		X	X
WR-SD-SD090 -0000A	Willamette River	0 - 90 cm[b]	< -2	X		X	X	X		X	X
WR-SD-SD092 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD096 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD100 -0000A	Willamette River	0 - 90 cm[b]	< -2	X		X				X	X
WR-SD-SD102 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X			X	X	X
WR-SD-SD106 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD116 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD117 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
Sediment Porewater											
WR-PW-SD089 -0000	see SD-SD089	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD096 -0000	see SD-SD096	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD102 -0000	see SD-SD102	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD106 -0000	see SD-SD106	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD116 -0000	see SD-SD116	0 - 10 cm[a]	< -2	X					X		

[a]Sediment sampling depth from which porewater will be extracted.

[b]90-152cm sediment horizon to be archived.

Sample numbers ending in 1000 are duplicate samples.

Table 3-5—Reach E Sampling Locations and Analyses

Sample Number	Location	Sample Depth (bgs)	Elevation (ft MLLW)	Analysis							
				TAL Metals	Titanium	BNAs	PCBs	Pest.	Organo-tins	TOC	Grain Size
Surface Sediment											
WR-SD-SD120 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD121 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD122 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD123 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD124 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD125 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD126 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD127 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD128 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD129 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD130 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD131 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD132 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD133 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X		X	X	X
WR-SD-SD134 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD135 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD136 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD137 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD137 -1000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD138 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD139 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD140 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD141 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD141 -1000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD142 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD143 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD144 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD145 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD146 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X
WR-SD-SD147 -0000	Willamette River	0 - 10 cm	< -2	X	X	X			X	X	X

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Table 3-5—Reach E Sampling Locations and Analyses

Sample Number	Location	Sample Depth (bgs)	Elevation (ft MLLW)	Analysis: TAL Metals	Titanium	BNAs	PCBs	Pest.	Organo-tins	TOC	Grain Size
WR-SD-SD148 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD149 -0000	Willamette River	0 - 10 cm	< -2	X		X				X	X
WR-SD-SD150 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD151 -0000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
WR-SD-SD151 -1000	Willamette River	0 - 10 cm	< -2	X	X	X	X	X	X	X	X
Subsurface Sediment											
WR-SD-SD120 -0000A	Willamette River	0 - 90 cm[b]	< -2	X		X				X	X
WR-SD-SD122 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X		X	X	X
WR-SD-SD125 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X		X	X	X
WR-SD-SD127 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X		X	X	X
WR-SD-SD133 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X		X	X	X
WR-SD-SD135 -0000A	Willamette River	0 - 90 cm[b]	< -2	X		X				X	X
WR-SD-SD136 -0000A	Willamette River	0 - 90 cm[b]	< -2	X		X				X	X
WR-SD-SD138 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD141 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD143 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X			X	X	X
WR-SD-SD150 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
WR-SD-SD151 -0000A	Willamette River	0 - 90 cm[b]	< -2	X	X	X	X	X	X	X	X
Sediment Porewater											
WR-PW-SD125 -0000	see SD-SD125	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD128 -0000	see SD-SD128	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD130 -0000	see SD-SD130	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD133 -0000	see SD-SD133	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD143 -0000	see SD-SD143	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD146 -0000	see SD-SD146	0 - 10 cm[a]	< -2	X					X		
WR-PW-SD146 -1000	see SD-SD146	0 - 10 cm[a]	< -2	X					X		

[a]Sediment sampling depth from which porewater will be extracted.

[b]90-152cm sediment horizon to be archived.

Sample numbers ending in 1000 are duplicate samples.

Table 4-1—Sample Containers, Preservation, and Holding Times

Analysis	Matrix	Containers[a] Field	Containers[a] Lab	Preservation	Holding Time[b]
TAL Metals, Titanium	Sediment	1 - 4 oz. glass	1 - 4 oz. glass	None	6 months (28 days Hg)
	Porewater	2 - 2 gallon HDPE buckets (sediment)	1 - 1 L polyethylene (extracted porewater)	HNO_3 to ph < 2 (lab)	
TCL Semivolatiles, PCBs	Sediment	1 - 8 oz. glass	1 - 8 oz. glass	Cool to 4° C	Extraction = 7 days Analysis = 40 days
Organotins	Sediment	1 - 8 oz. glass	1 - 8 oz. glass	Cool to 4° C	14 days
	Porewater	2 - 2 gallon HDPE buckets (sediment)	1 - 1 L polycarbonate (extracted porewater)	Cool to 4° C	7 days
Total Organic Carbon	Sediment	1 - 4 oz. glass	1 - 4 oz. glass	Cool to 4° C	14 days
Grain Size	Sediment	1 - 16 oz. glass	1 - 16 oz. glass	None	Not specified

[a]All glass containers will be wide-mouth.
[b]Holding times are from date of sample collection.

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Table 5-1—QA/QC Sample Types and Analyses

Sample Number	TAL Metals	Titanium	BNAs	PCBs	Pest.	Organo-tins	TOC	Grain Size	Purpose
Surface Sediment									
WR-SD-SD020-1000	X	X	X	X	X	X	X	X	Sediment field duplicate
WR-SD-SD048-1000	X	X	X	X	X	X	X	X	Sediment field duplicate
WR-SD-SD070-1000	X	X	X	X	X	X	X	X	Sediment field duplicate
WR-SD-SD092-1000	X	X	X	X	X	X	X	X	Sediment field duplicate
WR-SD-SD117-1000	X	X	X	X	X	X	X	X	Sediment field duplicate
WR-SD-SD137-1000	X	X	X	X	X	X	X	X	Sediment field duplicate
WR-SD-SD141-1000	X	X	X	X	X	X	X	X	Sediment field duplicate
WR-SD-SD151-1000	X	X	X	X	X	X	X	X	Sediment field duplicate
Subsurface Sediment									
WR-SD-SD048-1000A	X	X	X	X	X	X	X	X	Subsurface sediment field duplicate
WR-SD-SD084-1000A	X		X	X	X		X	X	Subsurface sediment field duplicate
Sediment Porewater									
WR-PW-SD074-1000	X					X			Porewater field duplicate
WR-PW-SD146-1000	X					X			Porewater field duplicate

042

Table 5-2–Analytical Methods, Parameters, and Quantitation Limits for Sediment Samples

Analyte	QL Goals	Reference Method
Inorganics (mg/kg dry weight)		
Aluminum	40	6010
Antimony	5	6010
Arsenic	5	6010/7060A
Barium	40	6010
Beryllium	1	6010
Cadmium	0.2	6010
Calcium	1000	6010
Chromium	0.5	6010
Cobalt	10	6010
Copper	0.2	6010
Iron	20	6010
Lead	2	6010
Magnesium	1000	6010
Manganese	5	6010
Mercury	0.05	7471A
Nickel	1	6010
Potassium	1000	6010
Selenium	15	6010/7740
Silver	1	6010/7761
Sodium	1000	6010
Thallium	5	6010/7841
Titanium	1	6010
Vanadium	10	6010
Zinc	5	6010
Semivolatile Organics (µg/kg dry weight)		
PAHs		
phenol	20	8270 - PSEP
bis(2-chloroethyl)ether	40	8270 - PSEP
2-chlorophenol	20	8270 - PSEP
1,3-dichlorobenzene	20	8270 - PSEP
1,4-dichlorobenzene	20	8270 - PSEP
1,2-dichlorobenzene	20	8270 - PSEP
2-methylphenol	20	8270 - PSEP
2,2'-oxybis(1-chloropropane)	40	8270 - PSEP
4-methylphenol	20	8270 - PSEP
N-nitroso-di-n-propylamine	40	8270 - PSEP
hexachloroethane	20	8270 - PSEP
nitrobenzene	20	8270 - PSEP
isophorone	20	8270 - PSEP
2-nitrophenol	20	8270 - PSEP
2,4-dimethylphenol	20	8270 - PSEP
bis(2-chloroethoxy)methane	40	8270 - PSEP
2,4-dichlorophenol	20	8270 - PSEP
1,2,4-trichlorobenzene	20	8270 - PSEP
naphthalene	20	8270 - PSEP
4-chloroaniline	20	8270 - PSEP
hexachlorobutadiene	20	8270 - PSEP
4-chloro-3-methylphenol	20	8270 - PSEP
2-methylnaphthalene	20	8270 - PSEP
hexachlorocyclopentadiene	20	8270 - PSEP
2,4,6-trichlorophenol	20	8270 - PSEP
2,4,5-trichlorophenol	20	8270 - PSEP
2-chloronaphthalene	20	8270 - PSEP

Table 5-2–Analytical Methods, Parameters, and Quantitation Limits for Sediment Samples

Analyte	QL Goals	Reference Method
2-nitroaniline	20	8270 - PSEP
dimethylphthalate	20	8270 - PSEP
acenaphthylene	20	8270 - PSEP
2,6-dinitrotoluene	20	8270 - PSEP
3-nitroaniline	20	8270 - PSEP
acenaphthene	20	8270 - PSEP
2,4-dinitrophenol	20	8270 - PSEP
4-nitrophenol	20	8270 - PSEP
dibenzofuran	20	8270 - PSEP
2,4-dinitrotoluene	20	8270 - PSEP
diethylphthalate	20	8270 - PSEP
4-chlorophenyl-phenylether	20	8270 - PSEP
fluorene	20	8270 - PSEP
4-nitroaniline	20	8270 - PSEP
4,6-dinitro-2-methylphenol	20	8270 - PSEP
N-nitrosodiphenylamine	40	8270 - PSEP
4-bromophenyl-phenylether	40	8270 - PSEP
hexachlorobenzene	20	8270 - PSEP
pentachlorophenol	20	8270 - PSEP
phenathrene	20	8270 - PSEP
anthracene	20	8270 - PSEP
carbazole	20	8270 - PSEP
di-n-butylphthalate	20	8270 - PSEP
fluoranthene	20	8270 - PSEP
pyrene	20	8270 - PSEP
butylbenzylphthalate	20	8270 - PSEP
3,3'-dichlorobenzidine	40	8270 - PSEP
benzo(a)anthracene	20	8270 - PSEP
chrysene	20	8270 - PSEP
bis(2-ethylhexyl)phthalate	20	8270 - PSEP
di-n-octylphthalate	20	8270 - PSEP
benzo(b)fluoranthene	20	8270 - PSEP
benzo(k)fluoranthene	20	8270 - PSEP
benzo(a)pyrene	20	8270 - PSEP
indeno(1,2,3-cd)pyrene	20	8270 - PSEP
dibenz(a,h)anthracene	20	8270 - PSEP
benzo(g,h,i)perylene	20	8270 - PSEP
PCBS (µg/kg dry weight)		
Aroclor 1016	20	8081 - PSEP
Aroclor 1221	40	8081 - PSEP
Aroclor 1232	20	8081 - PSEP
Aroclor 1242	20	8081 - PSEP
Aroclor 1248	20	8081 - PSEP
Aroclor 1254	20	8081 - PSEP
Aroclor 1260	20	8081 - PSEP
Pesticides (µg/kg dry weight)		
Aldrin	1	8081 - PSEP
a--BHC	1	8081 - PSEP
b--BHC	1	8081 - PSEP
g--BHC (Lindane)	1	8081 - PSEP
alpha-chlordane	1	8081 - PSEP
gamma-chlordane	1	8081 - PSEP
Dieldrin	2	8081 - PSEP

Table 5-2–Analytical Methods, Parameters, and Quantitation Limits for Sediment Samples

Analyte	QL Goals	Reference Method
Endrin	2	8081 - PSEP
Endosulfan	1	8081 - PSEP
Endosulfan II	2	8081 - PSEP
Endosulfan sulfate	2	8081 - PSEP
Methoxychlor	1	8081 - PSEP
Endrin ketone	2	8081 - PSEP
Endrin aldehyde	2	8081 - PSEP
Toxaphene	10	8081 - PSEP
Hexachlorobenzene	2	8270 - PSEP
Heptachlor	1	8081 - PSEP
Heptachlor epoxide	1	8081 - PSEP
Mirex	2	8081 - PSEP
4,4'-DDT	2	8081 - PSEP
4,4'-DDD	2	8081 - PSEP
4,4'-DDE	2	8081 - PSEP
Organotins (µg/kg dry weight)		
Monobutyltin	10	PSEP
Dibutyltin	10	PSEP
Tributyltin[c]	5	PSEP
Tetrabutyltin	10	PSEP
Physical and Conventional Parameters		
Grain size	0.01%	ASTM D-442-63/PSEP
Total Organic Carbon	200 mg/kg	9060-PSEP mod

QL - Quantitation Limit.

Table 5-3–Analytical Methods, Parameters, and Quantitation Limits for Porewater Samples

Analyte	QL Goals	Reference Method	US EPA Ambient Water Quality Criteria	Oregon State Ambient Water Quality Criteria
			Freshwater Chronic	Freshwater Chronic
Inorganics (µg/L)				
Aluminum	200	6010 / CLP	--	--
Antimony	60[d]	6010 / CLP	30[c]	1600[b]
Arsenic	10	6010 / CLP	190	190
Barium	200	6010 / CLP	--	--
Beryllium	5	6010 / CLP	5.3[b]	5.3[b]
Cadmium	5[d]	6010 / CLP	1.1+	1.1+
Calcium	5000	6010 / CLP	--	--
Chromium	10	6010 / CLP	210+	210+
Cobalt	50	6010 / CLP	--	--
Copper	2	6010	12+	12+
Lead	3	6010 / CLP	3.2+	3.2+
Magnesium	5000	6010 / CLP	--	--
Manganese	15	6010 / CLP	--	--
Mercury	0.1[d]	7471A	0.012	0.012
Nickel	10	6010	160+	160+
Potassium	5000	6010 / CLP	--	--
Selenium	5	6010 / CLP	5	35
Silver	0.2[d]	7761	0.12	0.12
Sodium	5000	6010 / CLP	--	--
Thallium	40	6010 / CLP	40[b]	40[b]
Vanadium	50	6010 / CLP	--	--
Zinc	20	6010 / CLP	110+	110+
Organotins (µg/L)				
Monobutyltin	0.10	PSEP	--	--
Dibutyltin	0.05	PSEP	--	--
Tributyltin[a]	0.020	PSEP	--	--
Tetrabutyltir	0.05	PSEP	--	--

[a]As described in Section 5.3, proposed lower and upper level screening values for tributyltin are 0.02 ug TBT/L and 0.05 ug TBT/L, respectively.

[b]Insufficient data to develop criterion; value presented is the Lowest Observed Effect Level (LOEL)

[c]Proposed criterion.

\+ Hardness dependent criteria (100 mg/l used).

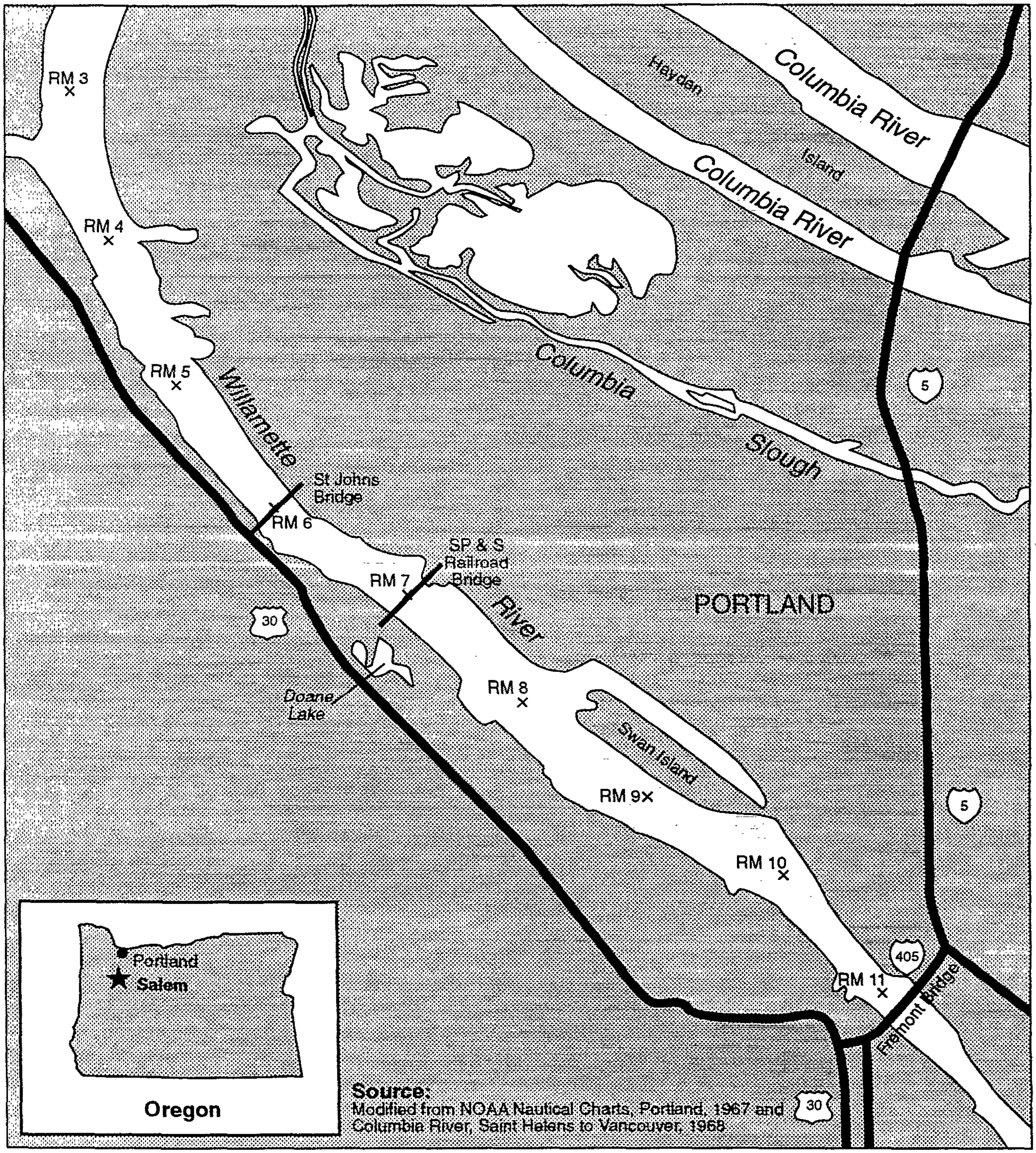
[d]Detection limit exceeds one or more screening criteria.

QL - Quantitation Limit.

AWQC - Ambient Water Quality Criteria.

-- Not available.

FIGURES



Source:
Modified from NOAA Nautical Charts, Portland, 1967 and Columbia River, Saint Helens to Vancouver, 1968

EXPLANATION

RM 1 × River Mile Marker with Identification

N

0 1/2 1

Scale in Miles

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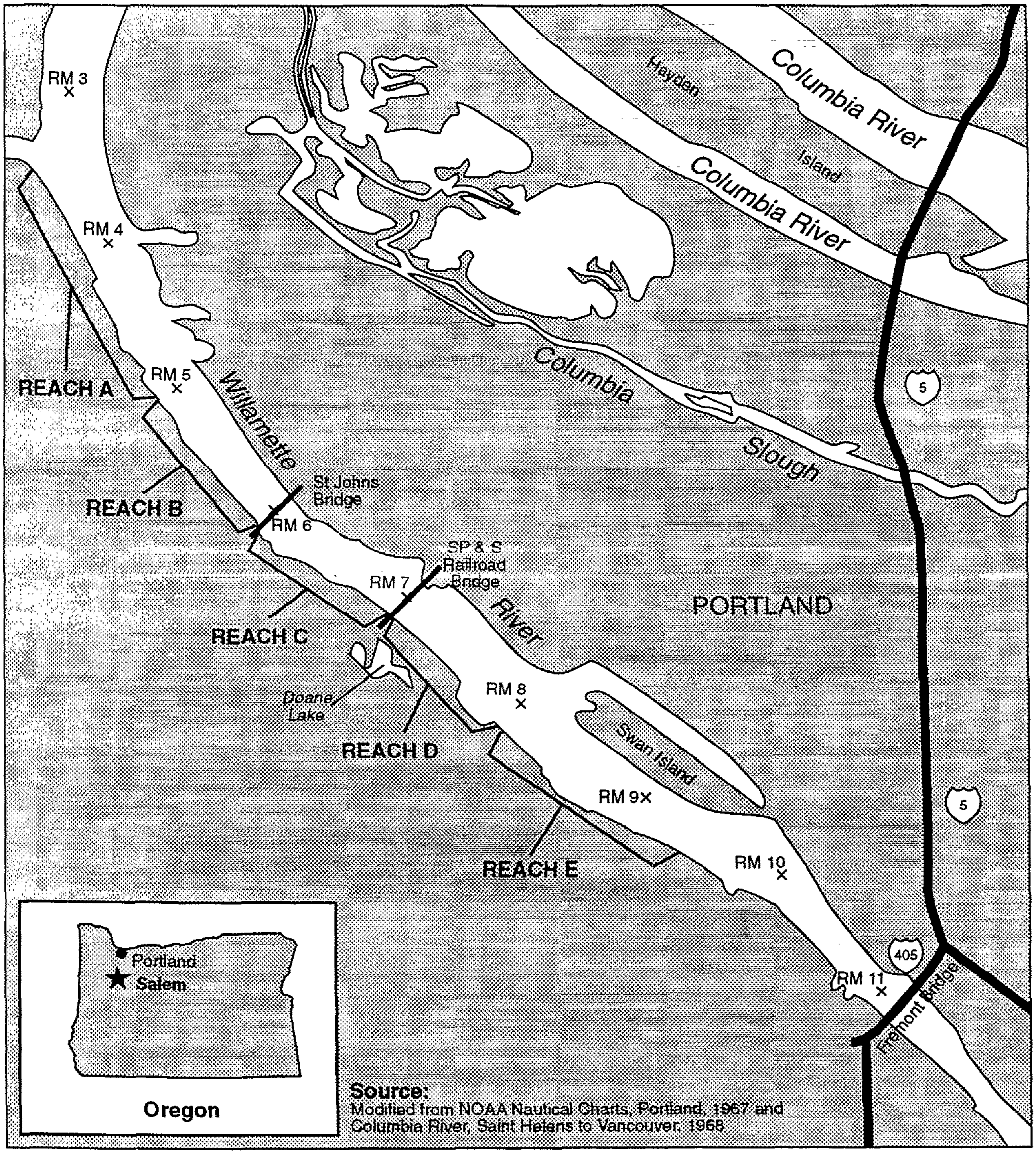
97-517 Fig1-1.fh7

Willamette River Site Investigation
Vicinity Map

048

FIGURE
1-1



EXPLANATION

RM 1 ✕ River Mile Marker with Identification

0 1/2 1
Scale in Miles

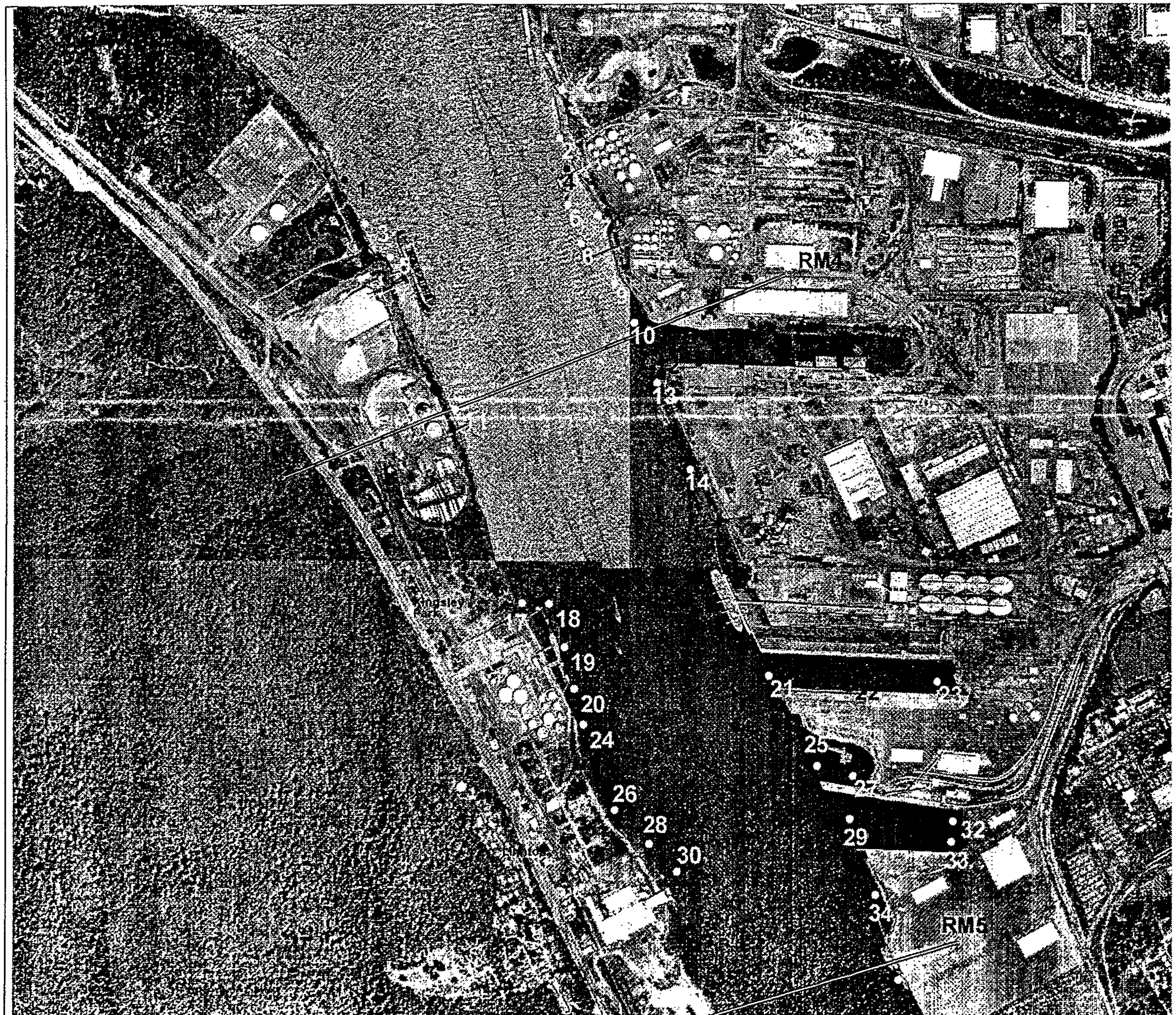
WESTON
MANAGERS DESIGNERS/CONSULTANTS

97-517 Fig3-1.fh7

Willamette River Site Investigation
River Reaches

049

FIGURE
3-1



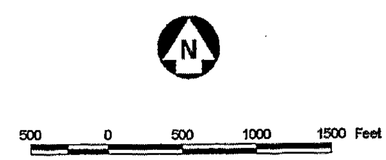
Willamette River Site Investigation Portland, Oregon

Reach A (RM 3.5 - RM 5.0)
Surface and Subsurface
Sediment Sampling
Locations

EXPLANATION:

Sampling Locations
- ● Surface and subsurface sediment sampling location
- Surface sediment sampling location

Note: All locations are approximate. Exact locations to be determined in the field.



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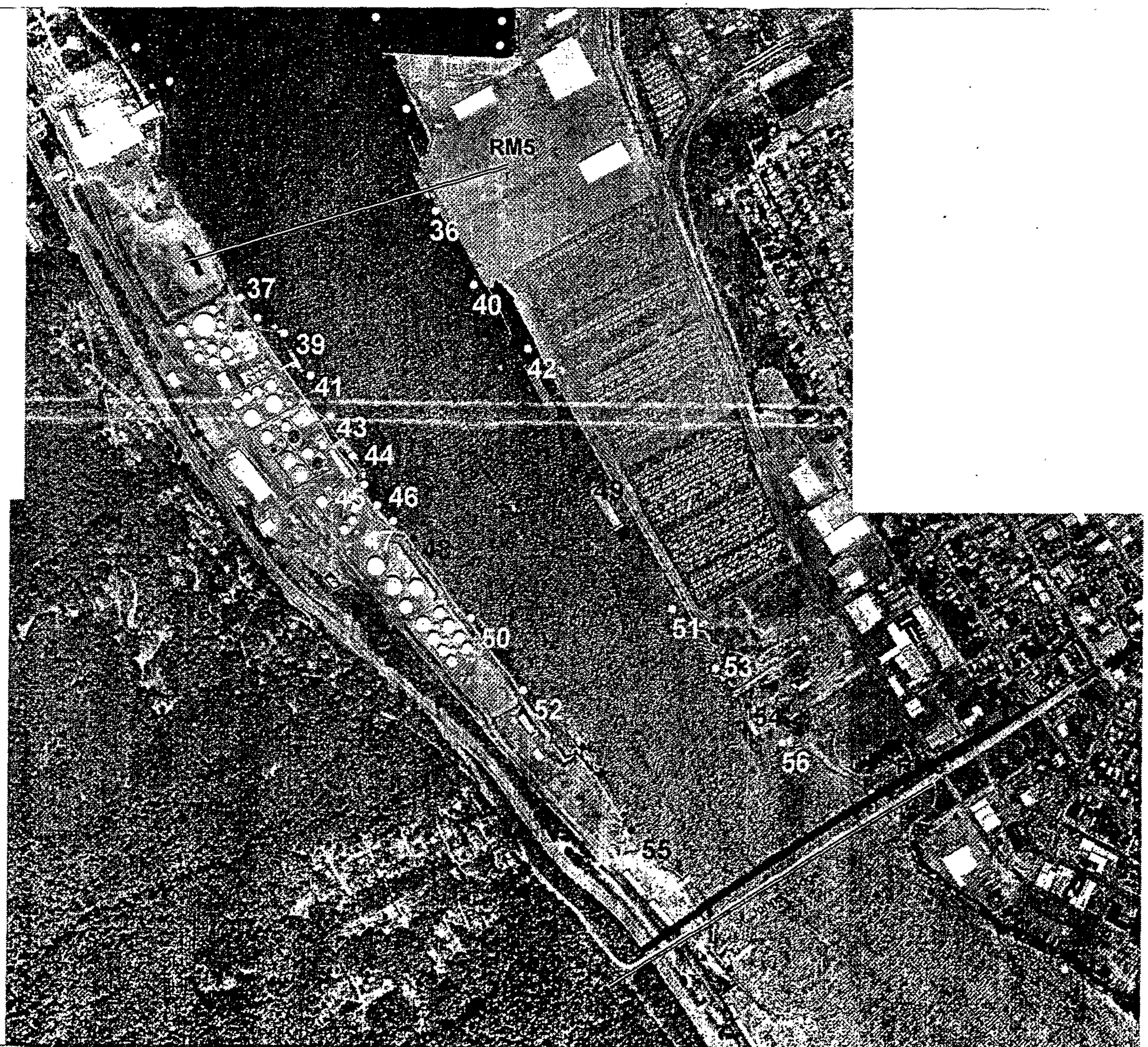
050

Figure
3-2



Willamette River Site Investigation Portland, Oregon

Reach B (RM 5.0 - RM 6.0) Surface and Subsurface Sediment Sampling Locations

EXPLANATION:

Sampling Locations
- ● *Surface and subsurface sediment sampling location*
- Surface sediment sampling location

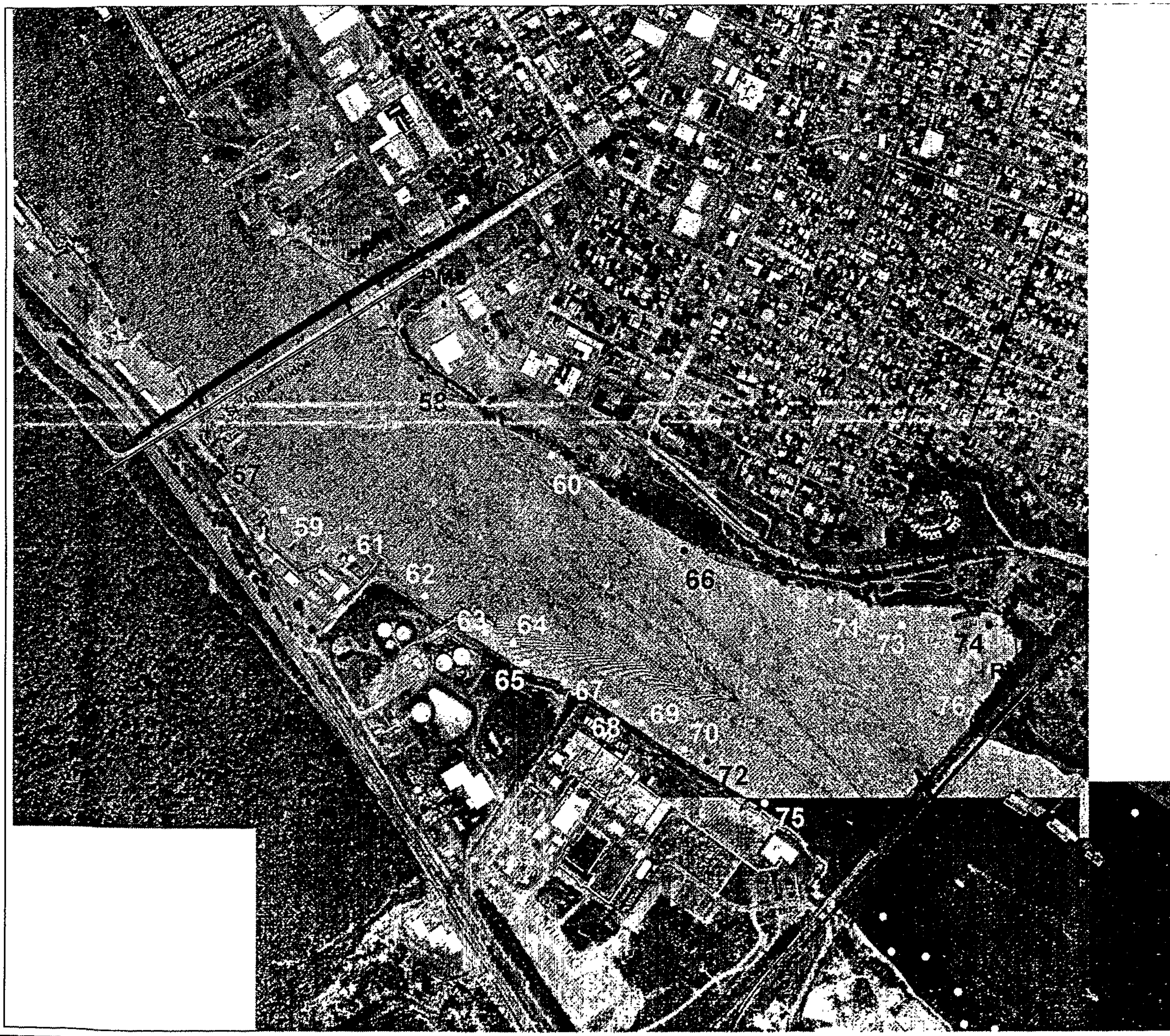
Note: All locations are approximate. Exact locations to be determined in the field.

N

500 0 500 1000 1500 Feet

WESTON

Figure
3-3



Willamette River Site Investigation Portland, Oregon

Reach C (RM 6.0 - RM 7.0) Surface and Subsurface Sediment Sampling Locations

EXPLANATION:

Sampling Locations
● Surface and subsurface sediment sampling location
Surface sediment sampling location

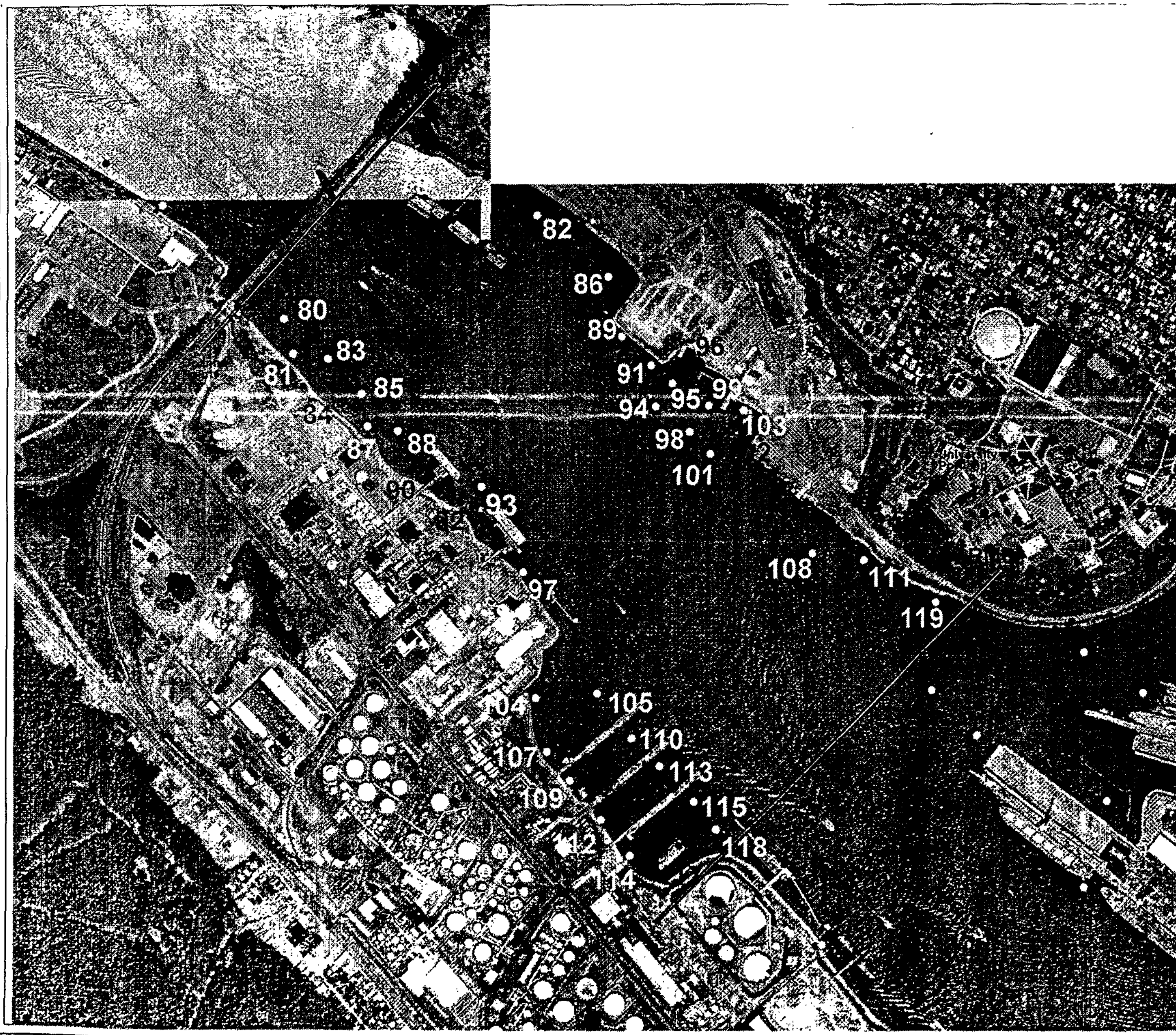
Note: All locations are approximate. Exact locations to be determined in the field.

N

500 0 500 1000 1500 Feet

052

Figure
3-4



Willamette River Site Investigation Portland, Oregon

Reach D (RM 7.0 - RM 8.0) Surface and Subsurface Sediment Sampling Locations

EXPLANATION:

Sampling Locations
- ● Surface and subsurface sediment sampling location
- Surface sediment sampling location

Note: All locations are approximate. Exact locations to be determined in the field.

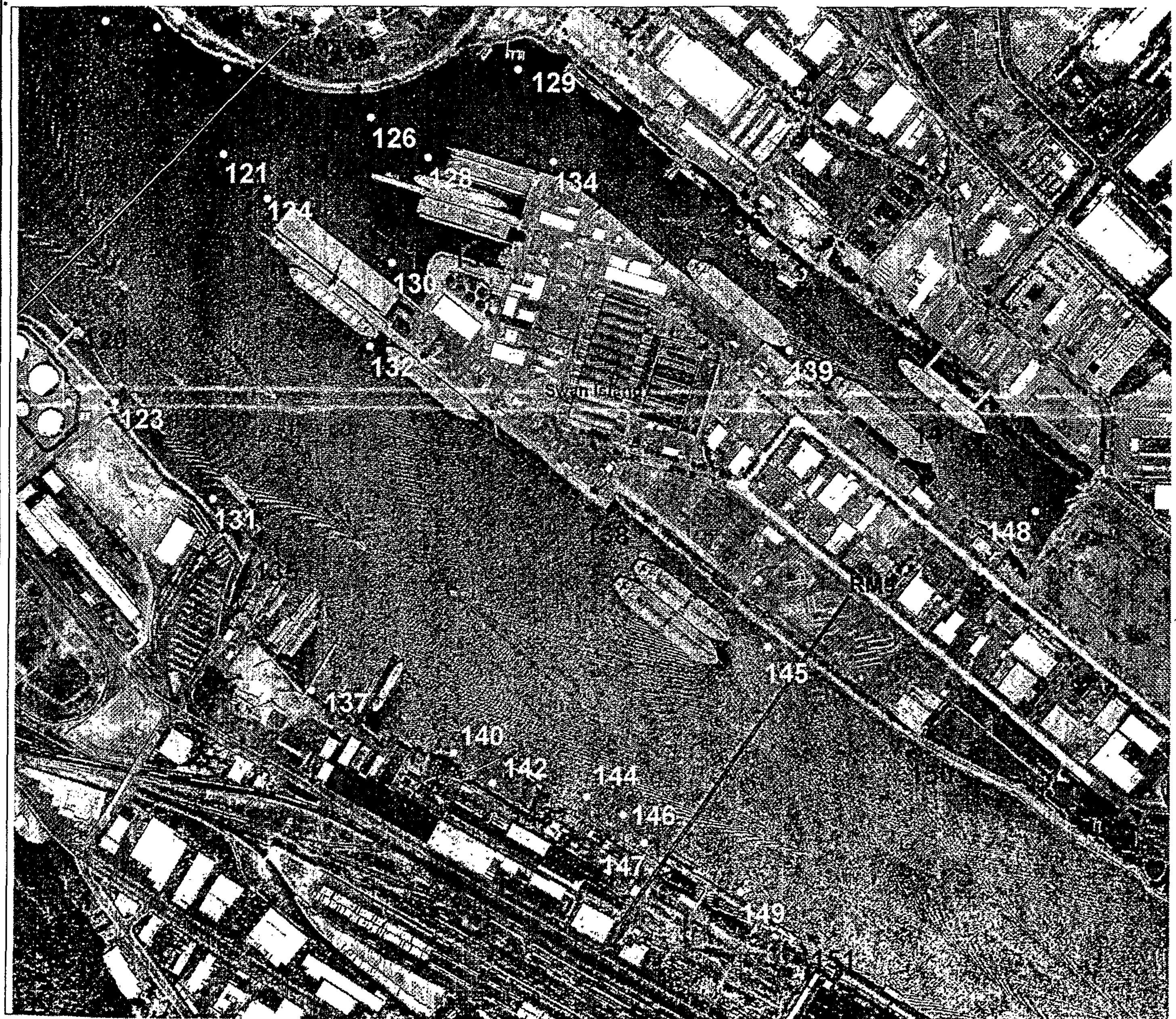
N

500 0 500 1000 1500 Feet

WESTON

053

Figure
3-5



Willamette River Site Investigation Portland, Oregon

Reach E (RM 8.0 - RM 9.5) Surface and Subsurface Sediment Sampling Locations

EXPLANATION:

Sampling Locations

- ● Surface and subsurface sediment sampling location
- Surface sediment sampling location

Note: All locations are approximate. Exact locations to be determined in the field.

N

500 0 500 1000 1500 Feet

WESTON

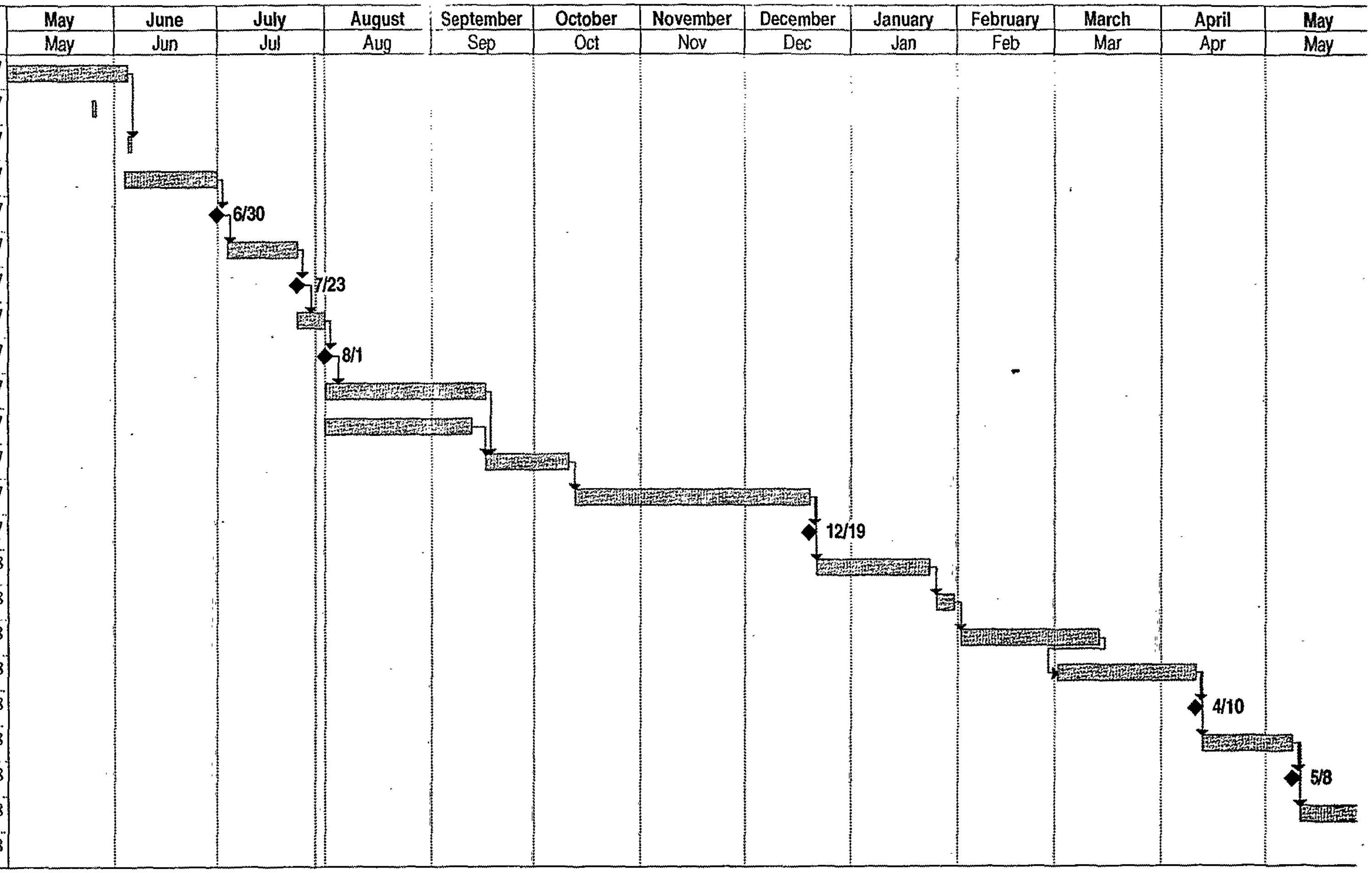
054

Figure

3-6

WILLAMETTE RIVER SITE INSPECTIONS SCHEDULE

ID	Task Name	Duration	Start	Finish
1	Summary Document Preparation	25d	5/1/97	6/4/97
2	Site Visit	1d	5/26/97	5/26/97
3	Summary Document Submittal	1d	6/5/97	6/5/97
4	Draft SAP Preparation	19d	6/4/97	6/30/97
5	Draft SAP Submittal	0d	6/30/97	6/30/97
6	Agency Review of Draft SAP	14d	7/4/97	7/23/97
7	Agency Comments Received	0d	7/23/97	7/23/97
8	Final SAP Preparation	6d	7/24/97	7/31/97
9	Final SAP Submittal	0d	8/1/97	8/1/97
10	Mobilization	33d	8/1/97	9/16/97
11	Subcontractor Procurement	31d	8/1/97	9/12/97
12	Sampling	18d	9/17/97	10/10/97
13	Sample Analysis	50d	10/13/97	12/19/97
14	Receipt of All Data from Labs	0d	12/19/97	12/19/97
15	Data Validation*	25d	12/22/97	1/23/98
16	Data Entry into Mgt System	5d	1/26/98	1/30/98
17	Data Evaluation	30d	2/2/98	3/13/98
18	Draft SI Report	30d	3/2/98	4/10/98
19	Draft SI Report Submittal	0d	4/10/98	4/10/98
20	Agency Review of Draft SI Rpt	20d	4/13/98	5/8/98
21	Agency Comments Received	0d	5/8/98	5/8/98
22	Final SI Report Preparation	15d	5/11/98	5/29/98
23	Final SI Report Submittal	0d	5/29/98	5/29/98



*The time period for data validation was extended due to the holiday season.

Figure 7

APPENDIX A

SEDIMENT FIELD SAMPLE RECORD FORM

WESTON® MANAGERS DESIGNERS/CONSULTANTS

SEDIMENT FIELD SAMPLE RECORD

Project Name:______________________ Sampling Personnel:______________________

Project Location:______________________ Sampling Vessel:______________________

Project No.:______________________ Subcontractor(s):______________________

Date:______________________ Weather:______________________

Sample No.:______________________ Sampling Method:______________________

Sample Location:______________________ Analysis:______________________

Prop. Coordinates:______________________

Grab #	Time	Depth to Sed. (ft/m)	Coordinates		Accpt. ?	Penet. Depth (cm)	Color	Texture	Odor	Sheens	Other
			X	Y							

Color Codes

BR = Brown
BK = Black
GY = Grey
GR = Green
RST = Rust

Texture Codes

SC = Silt/Clay
SD = Sand
GR = Granule
PB = Pebble
GV = Gravel

F = Fine
M = Medium
C = Coarse

Odor Codes

H2S = Sulfide
TPH = Petroleum

SL = Slight
M = Moderate
ST = Strong

Other:

Include presence of biota, debris, or redox layer

Sampler Signature:______________________________________

97-571.FRM(WP5.1)